

Chemical Hygiene Plan For East Hampton Public Schools

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I Purpose

- This plan is intended to protect the health and safety of science teachers and to promote the safe operation of the school laboratories to protect teachers (and students) from being overexposed to hazardous chemicals and to promote a culture of safety within the science department of East Hampton Public Schools.
- This plan is intended to ensure that hazardous materials are handled properly and disposed of in an environmentally proper manner.
- This plan is intended to ensure compliance with applicable Federal, State (OSHA Laboratory Standards 29 CFR 1910.1450) and local regulations.

II Scope

- This policy applies to all employees (science teachers) engaged in activities in science laboratories throughout the school district.

III Operations

- The following science laboratories/classrooms are covered by this policy:
 - **High School:** Chemistry Lab (room 17); Biology Labs (54, 55); Rooms 37 and 53; and chemical storeroom next to room 17 and biology storeroom between room 54 and 55.
 - **Middle School:** Rooms 10, 21, 32, 37 and prep closets in room 10 and 32

IV Responsibilities

School Board; Superintendent, Assistant Superintendent, Principals:

The school board and superintendent have the ultimate responsibility to ensure that the district complies with the Laboratory Standard. Their tasks include:

- Support and ensure enforcement of this policy
- Record all chemical exposures and allow employees access to their personal records, including all employee exposure and medical records.
- Ensure that medical consultative services are available to those employees requesting or needing such services
- Oversee and arrange for monitoring of worker exposures to hazardous materials if over the permissible exposure levels and if an OSHA Standard exists for the chemical involved
- Appoint and support the Chemical Hygiene Officer (CHO)

Chemical Hygiene Officer

- Works with the administrators and the teachers to administer the Chemical Hygiene Plan (CHP)
- Assists in the development of Standard Operating Procedures (SOP)
- Coordinates the safety education and training of employees, including
 - Understanding the hazards of chemicals they use in the laboratory
 - Recognizing signs and symptoms associated with overexposure to chemicals
 - Proper use of personal protective equipment (goggles, fume hoods, etc)
 - Protecting themselves from exposure by following good lab procedures
 - Understanding the content of the CHP
- Upon receipt of a chemical, reviews Material Safety Data Sheets (MSDS) for adequacy and compliance with OSHA Lab Standards and to ensure that proper labeling is applied. (*Chemical* is defined as a non-edible substance and not on the FDA Generally Recognized as Safe list)
- Provides access to all employees to the MSDS for all hazardous materials
- Conducts an annual inventory of all hazardous materials used in the laboratories and updates MSDS online data files and hard copy notebooks as needed.

- Reviews and monitors the disposal of hazardous materials. Maintain records of such disposal.
- Periodically and annually inspects the laboratories for compliance with this policy
- Evaluates the adequacy of personal protection equipment and, as necessary, recommends appropriate changes.
- Ensures that employees use the personal protection equipment provided
- Recommends engineering controls, ensure that the controls are used and periodically evaluates the controls to ensure proper functioning
- Reviews and updates the CHP annually
- Maintains all records associated with the CHP

Science Team Leader

- Assists CHO in safety education and training of all science teachers at their school
- Notifies the Principal in writing whenever emergencies arise or hazards exist such as
 - Defective gas or electrical fixtures
 - Broken or defective furniture
 - Inadequate storage cabinets
 - Lack of safety equipment such as fire extinguishers or eyewash stations
 - Broken or defective ventilation
 - Broken or defective safety equipment such as fume hoods, showers, eyewash, phone, etc.
- Ensures that combustible, flammables, poisonous, or otherwise dangerous chemicals are kept securely locked in appropriate storage cabinets
- Ensures that all cabinets containing dangerous chemicals are clearly marked with adequate warnings
- Inspects the chemical cabinets periodically and keeps a record of these inspections
- Ensures that protective and appropriate eyewear is available in all necessary locations as specified by law and that the goggles statute is posted
- Ensures that all personal protective equipment is labeled
- Obtains approval from the CHO before purchasing chemicals

Science Teachers

- Help develop Standard Operating Procedures and ensure that they are being followed
- Notify the CHO when a new hazardous chemical is to be used and work with the CHO to develop procedures for use of that chemical.
- Assist in the annual inventory of all laboratory chemicals. Efforts should be made to order only the amount of chemical likely to be consumed in a timely fashion.
- Efforts should be made to perform all laboratory activities with the least harmful chemical possible.
- Provide safety education to students at the beginning of each school year (or semester for half year courses)
- Distribute to students, review rules, and collect document after parents and students sign the Science Safety Acknowledgement document (see appendix for a copy of agreement)
- Provide appropriate safety information to students at the start of every laboratory activity.

V Standard Operating Procedures

General Employee Rules and Procedures

- Minimize all chemical exposures. Avoid underestimation of chemical hazards and risks.
- Know and understand the hazards of the chemical as stated in the MSDS and other references.
- Know how to properly store all chemicals in their compatible chemical families.
- Know proper procedures for transporting chemicals around the school.
- Know and implement proper disposal procedures before ordering or using any chemical.
- Read all chemical labels prior to use.
- Do not smell or taste chemicals.
- Skin contact or inhalation of chemicals should be avoided.
- Develop a firm goggle policy. Wear appropriate eye protection at all times. Chemical splash goggles must be worn any time chemicals, glassware or heat are used in the laboratory.
- Never work alone in the laboratory, chemical storage or prep areas.
- Flammable liquids require special attention. Never use these materials near any source of ignition, spark or open flame.
- Never perform a first-time chemical demonstration in front of your class. Always perform first-time demonstrations in front of other instructors to evaluate the safety of the demonstration.
- Never store chemicals over, under, or near a sink except for those used for cleaning purposes
- Only authorized personnel (certified science teachers, administrators, and trained custodial staff) should be allowed in the chemical storeroom.
- Use protective safety equipment to reduce potential exposure, i.e., gloves, respirators, fume hood
- Use a safety shield whenever an explosion or implosion might occur.
- Know the locations for all personal safety and emergency equipment—eyewash, shower, fire extinguisher and spill control materials. All safety and emergency equipment must be labeled.
- Train all students on how to use all safety devices in the laboratory (e.g., eyewash, shower, etc.) and teach all students and employees to find the safety devices quickly in an emergency.
- Neither students nor teachers are to use the fire extinguisher to put out a fire, per instructions of the Fire Marshal. Teachers and students are to immediately evacuate the room, closing all doors, and call for help.
- Have a 100% wool fire blanket easily accessible in case of an accident or fire.

- Know where and how to use master utility controls to shut off gas, electrical and water supplies.
- Know appropriate procedure in the event of a power failure.
- Know appropriate emergency procedures, evacuation routes, and fire emergency notification.
- Know the proper procedure for contacting the authorities: contact nurse at x304 (High School) and 404 (Middle School) and school administrators, including the CHO. Fill out accident reports as necessary, following the guidelines provided by the school nurse.
- All laboratory areas must be kept clean and orderly. Store all equipment and chemicals properly.
- Do not leave operating hotplates, running water, or open flames unattended
- Keep all cabinets and drawers closed when not in use to avoid catching or bumping hazards
- Clean all surfaces after use for chemical or biological activities.
- At no time should employees or students place themselves at risk to clean up spills. Report all spills to the Chemical Hygiene Officer and appropriate personnel for clean up.
- Maintain an MSDS library for all chemicals used or stored in the facility.
- Know and understand the personal hygiene practices outlined in the Chemical Hygiene Plan.
- First Aid Policy: In the event of a medical emergency, the teacher (or student if so directed or if the teacher is the injured party) is to call the school nurse at x304. The school nurse will determine whether to call 9-1-1 or whether the injury can be treated on site. Follow-up with the parent is the responsibility of the school nurse. The appropriate accident forms are to be filled out by the teacher. No First Aid kits are maintained in the labs, per school policy. All First Aid is to be administered by the nurse or emergency personnel.

Laboratory Procedures

- Science teachers are responsible for the safety education of their students at the beginning of each school year.
- Specific rules and procedures for students, and teachers, to follow are in the **Science Safety Acknowledgement** document (provided by National Science Teachers Association) found in the appendix of this document.

VI Chemical Spills and Other Emergency Procedures

- At no time should employees or students place themselves at risk to clean up spills. Report all spills to the Chemical Hygiene Officer and appropriate personnel for clean up.
- First Aid Policy: In the event of a medical emergency, the teacher (or student if so directed or if the teacher is the injured party) is to call the school nurse at x304(HS); or 404 (MS). The school nurse will determine whether to call 9-1-1 or whether the injury can be treated on site. Follow-up with the parent is the responsibility of the school nurse. The appropriate accident forms are to be filled out by the teacher as soon as possible. Workmen's Compensation forms are to be filled out as necessary. No First Aid kits are maintained in the labs, per school policy. All First Aid is to be administered by the nurse or emergency personnel.
- Neither students nor teachers are to use the fire extinguisher to put out a fire, per instructions of the Fire Marshal. Teachers and students are to immediately evacuate the room, closing all doors, and call for help.
- All spills, fires, or other emergencies shall be reported to the Superintendent and the CHO.

Large Chemical spills:

- Evacuate areas; close doors when applicable
- Decontaminate personnel if necessary using the shower and eyewash (in adjacent room if airborne) – see specific instructions below.
- Contact the school administrator who will contact emergency personnel with name, location, injuries, and chemical information. If a person is contaminated, follow the first aid policy stated above by calling the school nurse at x304(HS); 404(MS)
- Fill out appropriate accident report forms and inform the CHO.

Clothing Fires

- Stop the person on fire from running; even from running to a fire blanket.
- Drop the person to the floor or other horizontal surface to prevent flames and hot gases from rising to the face and head.
- Roll the person to snuff out the flames. Blankets can be effective if brought to the person. Safety showers may be effective if within a travel time of one or two seconds.
- Cool the person by removing smoldering clothing that has not adhered to the skin, and by using water and ice packs.
- Get medical assistance. Call school nurse at x304(HS); 404(MS). . Provide MSDSs for the involved chemicals to medical personnel.

Chemical splash

1. Chemical splashes in the eyes
 - Call the school nurse at x304(HS); 404(MS) . Provide MSDSs for the involved chemicals to medical personnel.
 - Immediately wash the eyes with potable water for at least 15 minutes. Allow the school nurse to take over the washing upon her arrival.

- Forcibly hold the eyelids open and tell the injured person to roll his/her eyes while continuously irrigating.
 - Do not use any substance other than potable water to wash the eyes.
2. Chemical splashes on the skin
- Call the school nurse at x304(HS); 404 (MS). Provide MSDSs for the involved chemicals to medical personnel. Allow the school nurse to take over the treatment upon her arrival but begin the following procedures immediately.
 - Remove chemical contact with the skin by brushing off dry and water reactive chemicals and removing contaminated clothing and protective equipment that can be removed quickly (1 second or less).
 - Flush the splashed area with large amounts of potable water. Never use anything other than water or mild soap and water to clean chemicals from exposed skin.
 - Remove protective eyewear under the emergency shower as quickly as possible when chemicals have entered the eyes. In cases where the eyewear has not been breached by the chemical, remove the protective eyewear after head and face have been thoroughly washed.
 - Wash with potable water for 15 minutes or longer. Wash any part of the skin that may have had chemical contact or contact with contaminated wash water. Remove any clothing that may have come in contact with the chemical or contaminated wash water under the emergency shower.
 - If the emergency water used for flushing is cold, the injured person should be treated for shock on completion of washing.
 - If a splash causes a thermal burn as well chemical burn, be sure to advise the attending medical personnel the nature of the chemical exposure.
 - After washing of the victim is completed, rescuers need to wash themselves to prevent injury from diluted chemical washed off from the victim.

VII Safety Equipment: Use, Requirements, Inspections

All safety equipment is to be inspected periodically and records are to be kept of these inspections.

First Aid: First Aid Policy: In the event of a medical emergency, the teacher (or student if so directed or if the teacher is the injured party) is to call the school nurse at x304. The school nurse will determine whether to call 9-1-1 or whether the injury can be treated on site. Follow-up with the parent is the responsibility of the school nurse. The appropriate accident forms are to be filled out by the teacher. Post emergency telephone numbers in the classroom/laboratory. Have a telephone or some means of emergency communication in the laboratory. No First Aid kits are maintained in the labs, per school policy. All First Aid is to be administered by the nurse or emergency personnel.

Ventilation: The chemical and biological laboratories and storage areas should be well-ventilated (a ventilation fan that can remove the air a minimum of four air changes per hour when unoccupied and eight changes per hour when occupied). Air for laboratory ventilation shall directly flow into the laboratory from non-laboratory areas and out to the exterior of the building. Ventilation must be checked a minimum of every **three months**.

Eyewash: All laboratories must have an eyewash station capable of treating both eyes continuously for 15 minutes with copious quantities of potable water. All teachers, employees, and students must be taught how to use the eyewash quickly in case of an emergency. Eyewash effectiveness and operation should be inspected and activated **at least every three months**. Promptly repair any eyewash that does not meet the water flow requirements of ANSI Z358.1. The head custodian in each building is responsible for the inspection and record keeping.

Safety Showers: Safety showers or body drenches should be provided. Showers should be inspected and activated at least every **six months**. Promptly repair any shower or body drench that does not meet the water flow requirements of ANSI Z358.1. The head custodian in each building is responsible for the inspection and record keeping.

Fire Extinguishers: Have appropriate types and sizes of fire extinguishers. ABC dry chemical fire extinguishers are appropriate for laboratories. Carbon dioxide fire extinguishers are not appropriate for laboratories. A Class D fire extinguisher should be available when working with flammable solids. Fire

extinguishers should be visually inspected **monthly** and maintained **annually**. The head custodian in each building is responsible for the inspection and record keeping.

Fire Blanket: All laboratories must have a 100% wool fire blanket available for spills and fire suppression.

Fume Hood: Fume hoods are not to be used for storage or disposal of chemicals. Laboratory activities that may release airborne contaminants above the permissible exposure limits or thresholds limit value must be carried out in the fume hood. Also, if lab activities produce potentially hazardous vapors or gaseous substances, these activities shall be conducted in the fume hood. The fume hood should be inspected annually. The fume hood must be operational at the level of 90-110 linear feet per minute, with 80% sash opening as measured by a velometer.

Flammables Cabinet: All chemicals designated as flammable on the MSDS shall be stored in the appropriate Flammables Cabinet. The cabinets are to be inspected **annually**. The head custodian in each building is responsible for the inspection and record keeping.

Poison Cabinet: Store all poisons inside a locked cabinet inside the locked storage room.

Goggles: All eyewear must meet ANSI Z87.1 Standard. Eye protection must be worn by teachers, students, and all visitors. Chemical splash goggles must be worn anytime chemicals, glassware, or heat are used in the lab. Goggles should be cleaned and sterilized between uses. The Goggle Statute must be posted.

Aprons, Gloves: The MSDS will provide information about the appropriate glove to be uses. Vinyl gloves are not to be used in a chemistry lab. Aprons should be of the appropriate size so as to prevent tripping hazards. The amount of protective apparel required shall be determined by the substances being handled.

Location of Equipment: An approved eyewash station, fire blanket, and fire extinguisher should be within 10 seconds (about 25 feet) of the chemical storage or use area.

Spill Control: Neutralizing chemicals, such as a spill kit, dry sand, Kitty Litter, and other spill control materials should be readily available.

Labeling: All safety items must be visible and placarded.

Waste Containers: Waste containers are to be stored in the storage rooms when not in use. Hazardous waste is to be stored separately and appropriately labeled.

Evacuation: All exits must be clearly marked. Keep all aisles clear and uncluttered. Access to exits, emergency equipment, and master utility controls must never be blocked. Have an alternative evacuation route in the event your primary route becomes blocked. Practice your emergency plans.

VIII Chemical Storage, Distribution and Waste Management:

- All chemicals are to be stored in tightly closed original containers with appropriate labeling
- All labels should include the date purchased (post 2010).
- All chemicals transferred to a secondary container must have appropriate labeling including date, contents, concentration, hazards, and name of teacher who transferred or prepared it.
- All chemicals are to be stored on labeled shelves according to the Flinn Storage system
- Acids are to be stored in the appropriate locked Acid Cabinets
- Flammables are to be stored in the appropriate locked Flammables Cabinets
- All storage areas are to be locked at all times when not in use. No students are to be allowed in the storage areas. Authorized people included certified science teachers, trained custodial staff, and administrators.
- Chemicals cannot be distributed for purposes other than instruction without the permission of the Chemical Hygiene Officer.
- Refrigerators that are used for the storage of chemicals or biological material may NOT be used for the storage of edible materials.
- All chemicals in the classroom are to be in locked cabinets when not in use. All science classrooms and laboratories are to be locked when a certified teacher is not present.
- All disposal of hazardous chemicals is to be in compliance with appropriate Department of Environmental Protection Hazardous Waste Management rules and regulations.
- Disposal of all other chemicals is to be in accordance with the disposal guidelines provided by Flinn Scientific, Inc.
- In the event of a chemical spill, if there is judged to be an immediate hazard, evacuation is to be absolute and the area shall be isolated until the proper emergency personnel arrive.
- If there is no immediate danger from the spill, then the appropriate spill control materials can be used and clean-up procedures as listed on the MSDS can be followed. For large spill of nonhazardous chemicals, contact the custodial staff.
- If the spill is of a hazardous material, then all clean up materials are also to be considered as hazardous materials and disposed of accordingly.

IX Curricular Changes:

All changes to existing curricula, and particularly those involving substantial changes to laboratory activities require the approval of the K-12 Science Coordinator and the Chemical Hygiene Officer to ensure that the new laboratory activities are appropriate for the grade-level and experience of the students and that they use the least harmful chemicals possible.

APPENDIX A: Science Laboratory Rules and Regulations

This is a copy (without the photos) of the Science Safety Acknowledgement Document provided to all science students (6-12).



science is a process of discovering and exploring the

natural world. Exploration occurs in the classroom/ laboratory or in the field. As part of your science class, you will be doing many activities and investigations that will involve the use of various materials, equipment, and chemicals. Safety in the science classroom/laboratory is the **FIRST PRIORITY** for students, instructors, and parents. To ensure safer classroom/laboratory/field experiences, the following **Science Laboratory Rules and Regulations** have been developed for the protection and safety of all. Your instructor will provide additional rules for specific situations or settings. The rules and regulations must be followed at all times. After you have reviewed them with your instructor, read and review the rules and regulations with your parent/guardian. Their signature and your signature are required before you will be permitted to participate in any activities or investigations. Your signature indicates that you have read these rules and regulations, understand them, and agree to follow them at all times while working in the classroom/laboratory or in the field.

Standards of Student Conduct in the Laboratory and in the Field

1. Conduct yourself in a responsible manner at all times in the laboratory. Frivolous activities, mischievous behavior, throwing items, and conducting pranks are prohibited.
2. Lab and safety information and procedures must be read ahead of time. All verbal and written instructions shall be followed in carrying out the activity or investigation.
3. Eating, drinking, gum chewing, applying cosmetics, manipulating contact lenses, and other unsafe activities are not permitted in the laboratory.
4. Working in the laboratory without the instructor present is prohibited.
5. Unauthorized activities or investigations are prohibited. Unsupervised work is not permitted.
6. Entering preparation or chemical storage areas is prohibited at all times.
7. Removing chemicals or equipment from the laboratory is prohibited unless authorized by the instructor.

Personal Safety

8. ANSI Z87.1 approved chemical splash goggles or safety glasses, as appropriate or directed by your instructor, shall be worn at all times in the laboratory or field, including pre-laboratory work and clean-up, unless the instructor specifically states that the activity does not require the use of chemical splash goggles or safety glasses.
9. When an activity requires the use of laboratory aprons, the apron shall be appropriate to the size of the student and the hazard associated with the activity or investigation. The apron shall remain tied throughout the activity or investigation.
10. All accidents, chemical spills, and injuries must be reported immediately to the instructor, no matter how trivial they may seem at the time. Follow your instructor's directions for immediate treatment.
11. Dress appropriately for laboratory work by protecting your body with clothing and shoes. This means that you should use hair ties to tie back long hair and tuck into the collar. Do not wear loose or baggy clothing or dangling jewelry on laboratory days. Acrylic nails are also a safety hazard near heat sources and should not be used. Sandals or open-toed shoes are not to be worn during any lab activities. Refer to prelab instructions. If in doubt, ask!
12. Know the location of all safety equipment in the room. This includes eye wash stations, the deluge shower, fire extinguishers, the fume hood, and the safety blanket. Know the location of emergency master electric and gas shut offs and exits.
13. Certain classrooms may have living organisms including plants in aquaria or other containers. Students must not handle organisms without specific instructor authorization. Wash your hands with soap and water after handling organisms and plants.
14. When an activity or investigation requires the use of laboratory gloves for hand protection, the gloves shall be appropriate for the hazard and worn throughout the activity.

Specific Safety Precautions Involving Chemicals and Lab Equipment

15. Avoid inhaling in fumes that may be generated during an activity or investigation.
16. Never fill pipettes by mouth suction. Always use the suction bulbs or pumps.
17. Do not force glass tubing into rubber stoppers. Use glycerin as a lubricant and hold the tubing with a towel as you ease the glass into the stopper.
18. Proper procedures shall be followed when using any heating or flame producing device especially gas burners. Never leave a flame unattended.
19. Remember that hot glass looks the same as cold glass. After heating, glass remains hot for a very long time. Determine if an object is hot by placing your hand close to the object but do not touch it.
20. Should a fire drill or other evacuation emergency occur during an investigation or activity, make sure you turn off all gas burners and electrical equipment and exit the room as directed.
21. Always read the reagent bottle labels twice before you use the reagent. Be certain the chemical you use is the correct one.
22. Replace the top on any reagent bottle as soon as you have finished using it and return the reagent to the designated location.
23. Do not return unused chemicals to the reagent container. Follow the instructor's directions for the storage or disposal of these materials.

Standards for Maintaining a Safer Laboratory Environment

24. Backpacks and books are to remain in an area designated by the instructor and shall not be brought into the laboratory area.
25. Never sit on laboratory tables.
26. Work areas should be kept clean and neat at all times. Work surfaces are to be cleaned at the end of each laboratory or activity.
27. Solid chemicals, metals, matches, filter papers, broken glass, and other materials designated by the instructor are to be deposited in the proper waste containers, not in the sink. Follow your instructor's directions for disposal of waste.
28. Sinks are to be used for the disposal of water and those solutions designated by the instructor. Other solutions must be placed in the designated waste disposal containers.
29. Glassware is to be washed with hot, soapy water and scrubbed with the appropriate type and sized brush, rinsed, dried, and returned to its original location.
30. Goggles are to be worn during the activity or investigation, clean up, and through hand washing.

I have read the above science laboratory rules and regulations, and I agree to follow them during any science course, investigation, or activity. I acknowledge that these rules are necessary to prevent accidents and to ensure my own safety and the safety of others around me. I will follow any additional instructions given by my instructor.

I understand that I may ask my instructor at any time about the rules and regulations if they are not clear to me. My failure to follow these science laboratory rules and regulations may result in discipline.

_____	_____
Student Signature	Date
_____	_____
Parent/Guardian Signature	Date

Please keep these pages in the front of the laboratory section of your notebook.

Provided by the National Science Teachers Association

APPENDIX B: OSHA Lab Standard

OSHA Laboratory Standard

29 CFR 1910.1450

PART 1910-OCCUPATIONAL SAFETY AND HEALTH STANDARDS

1. The authority citation for part 1910, subpart Z is amended by adding the following citation at the end. (Citation which precedes asterisk indicates general rulemaking authority.)

Authority: Secs. 6 and 8, Occupational Safety and Health Act, 29 U.S.C. 655, 657; Secretary of Labor's Orders Nos. 12-71 (36 FR 8754), 8-76 (41 FR 25059), or 9-83 (48 FR 35736), as applicable; and 29 CFR part 1911.

* * * Section 1910.1450 is also issued under sec. 6(b), 8(c) and 8(g)(2), Pub.L. 91-596, 84 Stat. 1593, 1599, 1600; 29 U.S.C. 655, 657.

2. Section 1910.1450 is added to subpart Z, part 1910 to read as follows:

191.1450 Occupational exposure to hazardous chemicals in laboratories.

(a) *Scope and application.* (1) This section shall apply to all employers engaged in the laboratory use of hazardous chemicals as defined below.

(2) Where the section applies it shall supersede, for laboratories, the requirements of all other OSHA health standards in 29 CFR part 1910, subpart Z, except as follows:

(i) For any OSHA health standard, only the requirement to limit employee exposure to the specific permissible exposure limit shall apply for laboratories, unless that particular standard states otherwise or unless the conditions of paragraph (a)(2)(iii) of this section apply.

(ii) Prohibition of eye and skin contact where specified by any OSHA health standard shall be observed.

(iii) Where the action level (or in the absence of action level, the permissible exposure limit) is routinely exceeded for an OSHA regulated substance with exposure monitoring and medical surveillance requirements, paragraphs (d) and (g)(1)(ii) of this section shall apply.

(3) This section shall not apply to:

(i) Uses of hazardous chemicals which do not meet the definition of laboratory use, and in such cases, the employer shall comply with the relevant standard in 29 CFR part 1910, subpart Z, even if such occurs in a laboratory.

(ii) Laboratory uses of hazardous chemicals which provide no potential for employee exposure. Examples of such conditions might include:

(A) Procedures using chemically-impregnated test media such as Dip-and-Read tests where a reagent strip is dipped into the specimen to be tested and the results are interpreted by comparing the color chart supplied by the manufacturer of the test strip; and
(B) Commercially prepared kits such as those used in performing pregnancy tests in which all of the reagents needed to conduct the test are contained in the kit.

(b) *Definitions-*

"Action level" means a concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight (8)-hour timeweighted

average, which initiates certain required activities such as exposure monitoring and medical surveillance.

"Assistant Secretary" means the Assistant Secretary of labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

"Carcinogen" (see "select carcinogen").

"Chemical Hygiene Officer" means an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and

implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitation on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

"Chemical Hygiene Plan" means a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that (i) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and (ii) meets the requirements of paragraph (e) of this section.

"Combustible liquid" means any liquid having a flashpoint at or above 100 °F (37.8 °C), but below 200 °F (93.3 °C), except any mixture having components with flashpoints of 200 °F (93.3 °C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

"Compressed Gas" means"

(i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 °F (21.1 °C); or

(ii) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 °F (54.4 °C) regardless of the pressure at 70 °F (21.1 °C); or

(iii) A liquid having a vapor pressure exceeding 40 psi at 100 °F (37.8 °C) as determined by ASTM D-323-72.

"Designated Area" means an area which may be used for work with "select carcinogens" reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as a laboratory hood.

"Emergency" means any occurrence such as, but not limited to, equipment failure, rupture or containers or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace.

"Employee" means an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

"Explosive" means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

"Flammable" means a chemical that falls into one of the following categories:

(i) *"Aerosol, flammable"* means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame protection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;

(ii) *"Gas, flammable"* means:

(A) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent b volume or less; or

(B) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit.

(iii) *"Liquid, flammable"* means any liquid having a flashpoint below 100 °F (37.8 °C), except any mixture having components with flashpoints of 100 °F (37.8 °C) or higher, the total of which make up 99 percent of more of the total volume of the mixture.

(iv) *"Solid, flammable"* means a solid, other than a blasting agent or explosive as defined in 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

"Flashpoint" means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:

(i) Tagliabue Closed Tester (See American National Standard

for Flash Point by Tag Closed Tester, Z11.7-1979 (STM D93-79))- for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100 °F (37.8 °C), than do not contain suspended solids and do not have a tendency to form a surface film under test; or

(ii) Pinsky-Martens Closed Tester (see American National Standard Method of Test for Flash Point by Pinsky-Martens Closed Tester, Z11.7-1979 (ASTM D 93-79))-for liquids with a viscosity equal to or greater than 45SUS at 100 °F (37.8 °C), or that contain suspended solids, or that have a tendency to form a surface film under test; or

(iii) Setaflash Closed Tester (see American National standard Method of Test for Flash Point by Setaflash Closed Tester (ASTM D3278-78)).

Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

"*Hazardous chemical*" means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees.

The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hemopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes. Appendices A and B of the Hazard Communication Standard (29CFR 1910.1200) provide further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard.

"*Laboratory*" means a facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a nonproduction basis.

"*Laboratory scale*" means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.

"*Laboratory-type hood*" means a device located in a laboratory, enclosure on five sides with a moveable sash or fixed partial enclosed on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure with out insertion of any portion of the employee's body other than hands and arms. Walk-in hoods with adjustable sashes meet the above definition provided that the sashes are adjusted during use to that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

"*Laboratory use of hazardous chemicals*" means handling or use of such chemicals in which all of the following conditions are met:

- (i) Chemical manipulations are carried out on a "laboratory scale;"
- (ii) Multiple chemical procedures or chemicals are used;
- (iii) The procedures involved are not part of a production process, nor in any way simulate a production process; and
- (iv) "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

"*Medical consultation*" means a consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examination or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

"*Organic peroxides*" means an organic compound that contains the bivalent -O-O- structure and which may be considered to be a

structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

"*Oxidizer*" means a chemical other than a blasting agent or explosive as defined in 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

"*Physical hazard*" means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

"*Protective laboratory practices and equipment*" means those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

"*Reproductive toxins*" means chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis)

"*Select carcinogen*" means any substance which meets one of the following criteria:

- (i) It is regulated by OSHA as a carcinogen; or
- (ii) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or
- (iii) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or

(iv) It is listed in either Group 2A or @B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

- (A) After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m³;
- (B) After repeated skin application of less than 300 (mg/kg of body weight) per week; or
- (C) After oral dosages of less than 50 mg/kg of body weight per day.

"*Unstable (reactive)*" means a chemical which is the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

"*Water-reactive*" means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

(c) *Permissible exposure limits*. For laboratory uses of OSHA regulated substances, the employer shall assure that laboratory employees' exposures to such substances do not exceed the permissible exposure limits specified in 26 CFR par 1910, subpart Z.

(d) *Employee exposure determination*-(1) *Initial monitoring*. The employer shall measure the employee's exposure to any substance regulated by a standard which requires monitoring if there is reason to believe that exposure levels for that substance routinely exceed the action level (or in the absence of an action level, the PEL).

(2) *Periodic monitoring*. If the initial monitoring prescribed by paragraph (d)(1) of this section discloses employee exposure over the action level (or in the absence of an action level, the PEL), the employer shall immediately comply with the exposure monitoring provisions of the relevant standard.

(3) *Termination of monitoring*. Monitoring may be terminated in accordance with the relevant standard.

(4) *Employee notification of monitoring results*. The employer shall, within 15 working days after the receipt of any monitoring results, notify the employee of these results in writing either individually or by posting results in an appropriate location that is accessible to employees.

(e) *Chemical hygiene plan-General*. (Appendix A of this section is non-mandatory but provides guidance to assist employers in the development of the Chemical Hygiene Plan). (1) Where hazardous

chemicals as defined by this standard are used in the workplace, the employer shall develop and carry out the provisions of a written Chemical Hygiene Plan which is:

- (i) Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory and
 - (ii) Capable of keeping exposures below the limits specified in paragraph (c) of this section.
- (2) The Chemical Hygiene Plan shall be readily available to employees, employee representatives and, upon request, to the Assistant Secretary.
- (3) The Chemical Hygiene Plan shall include each of the following elements and shall indicate specific measures that the employer will take to ensure laboratory employee protection:
- (i) Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals;
 - (ii) Criteria that the employer will use to determine and implement control measures to reduce employee exposure to hazardous chemicals including engineering controls, the use of personal protective equipment and hygiene practices; particular attention shall be given to the selection of control measure for chemicals that are known to be extremely hazardous;
 - (iii) A requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment;
 - (iv) Provisions for employee information and training as prescribed in paragraph (f) of this section;
 - (v) The circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or the employer's designee before implementation;
 - (vi) Provisions for medical consultation and medical examinations in accordance with paragraph (g) of this section;
 - (vii) Designation of personnel responsible for implementation of Chemical Hygiene Plan including the assignment of a Chemical Hygiene Officer and, if appropriate, establishment of a Chemical Hygiene Committee; and
 - (viii) Provisions for additional employee protection for work with particularly hazardous substances. These include "select carcinogens," reproductive toxins and substances which have a high degree of acute toxicity. Specific consideration shall be given to the following provisions which shall be included where appropriate:
 - (A) Establishment of a designated area;
 - (B) Use of containment devices such as fume hood or glove boxes;
 - (C) Procedures for safe removal of contaminated waste; and
 - (D) Decontamination procedures.
- (4) The employer shall review and evaluate the effectiveness of the Chemical Hygiene Plan at least annually and update it as necessary.
- (f) *Employee information and training.* (1) The employer shall provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area.
- (2) Such information shall be provided at the time of an employees' initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. The frequency of refresher information and training shall be determined by the employer.
- (3) *Information.* Employees shall be informed of:
- (i) The contents of this standard and its appendices which shall be made available to employees;
 - (ii) The location and availability of the employer's Chemical Hygiene Plan;
 - (iii) The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard;
 - (iv) Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and

(v) The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Material Safety Data Sheets received from the chemical supplier.

(4) *Training.* (1) Employee training shall include:

(A) Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

(B) The physical and health hazards of chemicals in the work area; and

(C) The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

(ii) The employee shall be trained on the applicable details of the employer's written Chemical Hygiene Plan.

(g) *Medical consultation and medical examinations.* (1) The employer shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

(i) Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination.

(ii) Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected employee as prescribed by the particular standard.

(iii) Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided and opportunity for a medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination.

(2) All medical examinations and consultations shall be performed by or under the direct supervision of a licensed physician and shall be provided without cost to the employee, without loss of pay and at a reasonable time and place.

(3) *Information provided to the physician.* The employer shall provide the following information to the physician:

(i) The identity of the hazardous chemical(s) to which the employee may have been exposed;

(ii) A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and

(iii) A description of the signs and symptoms of exposure that the employee is experiencing, if any.

(4) *Physician's written opinion.* (i) For examination or consultation required under this standard, the employer shall obtain a written opinion from the examining physician which shall include the following:

(A) Any recommendation for further medical follow-up;

(B) The results of the medical examination and any associated tests;

(C) Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous chemical found in the workplace; and

(D) A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

(ii) The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

(h) *Hazard identification.* (1) With respect to labels and material safety data sheets:

(i) Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced.

(ii) Employers shall maintain any material safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible to laboratory employees.

(2) The following provisions shall apply to chemical substances developed in the laboratory:

(i) If the composition of the chemical substance which is produced exclusively for the laboratory's use is known, the employer shall determine if it is a hazardous chemical as defined in paragraph (b) of this section. If the chemical is determined to be hazardous, the employer shall provide appropriate training as required under paragraph (f) of this section.

(ii) If the chemical produced is a byproduct whose composition is not known, the employer shall assume that the substance is hazardous and shall implement paragraph (e) of this section.

(iii) If the chemical substance is produced for another user outside of the laboratory, the employer shall comply with the Hazard Communication Standard (26 CFR 1910.1200) including requirements for preparation of material safety data sheets and labeling.

(i) *Use of respirators.* Where the use of respirators is necessary to maintain exposure below permissible exposure limits, the employer shall provide, at no cost to the employee, the proper respiratory equipment. Respirators shall be selected and used in accordance with the requirements of 29 CFR 1910.134.

(j) *Recordkeeping.* (1) The employer shall establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultation and examinations including test or written opinions required by this standard.

(2) The employer shall assure that such records are kept, transferred, and made available in accordance with 29 CFR 1910.20.

(k) *Dates-(1) Effective date.* This section shall become effective May 1, 1990.

(2) *Start-up dates.* (i) Employers shall have developed and implemented a written Chemical Hygiene Plan no later than January 31, 1991.

(ii) Paragraph (a)(2) of this section shall not take effect until the employer has developed and implemented a written Chemical Hygiene Plan.

(l) *Appendices.* The information contained in the appendices is not intended, by itself, to create any additional obligations not otherwise imposed or to detract from any existing obligation.

Appendix A to 1910.1450-National Research Council Recommendations Concerning Chemical Hygiene in Laboratories (Non-Mandatory)

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Foreword

As guidance for each employer's development of an appropriate laboratory Chemical Hygiene Plan, the following non-mandatory recommendations are provided. They were extracted from "Prudent Practices for handling Hazardous Chemical in Laboratories" (referred to below as "Prudent Practices"), which was published in 1981 by the National Research Council and is available from the National Academy Press, 2101 Constitution Ave., NW., Washington DC 20418.

"Prudent Practices" is cited because of its wide distribution and acceptance and because of its preparation by members of the laboratory community through the sponsorship of the National Research Council. However, none of the recommendations given here will modify any requirements of the laboratory standard. This Appendix merely presents pertinent recommendations from "Prudent Practices", organized into a form convenient for quick reference during operation of a laboratory facility and during development and application of a Chemical Hygiene Plan. Users of this appendix should consult "Prudent Practices" for a more extended presentation and justification for each recommendation. "Prudent Practices" deals with both safety and chemical hazards while the laboratory standard is concerned primarily with chemical hazards. Therefore, only those recommendation directed primarily toward control of toxic exposures are cited in this appendix, with the term "chemical hygiene" being substituted for the word "safety". However, since conditions producing or threatening physical injury often pose toxic risks as well, page references concerning major categories of safety hazards in the laboratory are given in section F.

The recommendations from "Prudent Practices" have been paraphrased, combined, or otherwise reorganized, and headings have been added. However, their sense has not been changed.

Corresponding Sections of the Standard and this Appendix

The following table is given for the convenience of those who are developing a Chemical Hygiene Plan which will satisfy the requirements of paragraph (e) of the standard. It indicates those sections of this appendix which are most pertinent to each of the sections of paragraph (e) and related paragraphs.

Paragraph and topic in laboratory standard Relevant appendix section

(e)(3)(i) Standard operating procedures for handling toxic chemicals.

C, D, E

(e)(3)(ii) Criteria to be used for implementation of measures to reduce exposure.

D

(e)(3)(iii) Fume hood performance C4b

(e)(3)(iv) Employee information and training (including emergency procedures).
D10, D9

(e)(3)(v) Requirements for prior approval of laboratory activities.

E2b, E4b

(e)(3)(vi) Medical consultation and medical examinations

D5, E4f

(e)(3)(vii) Chemical hygiene responsibilities.

B

(e)(3)(viii) Special precautions for work with particularly hazardous substances.

E2, E3, E4

In this appendix, those recommendations directed primarily at administrators and supervisors are given in sections A-D. Those recommendations of primary concern to employees who are actually handling laboratory chemical are given in section E. (Reference to page numbers in "Prudent Practices" are given in parentheses.)

A. General Principles for Work with Laboratory Chemicals

In addition to the more detailed recommendations listed below in sections B-E, "Prudent Practices" expresses certain general principles, including the following:

1. *It is prudent to minimize all chemical exposures.* Because few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals should be adopted, rather than specific guidelines for particular chemicals (2, 10). Skin contact with chemicals should be avoided as a cardinal rule (198).

2. *Avoid underestimation of risk.* Even for substances of no known significant hazard, exposure should be minimized; for work with special precautions should be taken 910, 37, 38). One should assume that any mixture will be more toxic than its most toxic component (30,103) and that all substances of unknown toxicity are toxic (3, 34).

3. *Provide adequate ventilation.* The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by use of hoods and other ventilation devices (32, 198).

4. *Institute a chemical hygiene program.* A mandatory chemical hygiene program designed to minimize exposures is needed; it should be a regular, continuing effort, not merely a standby or short-term activity (6, 11). Its recommendations should be followed in academic teaching laboratories as well as by full-time laboratory workers (13).

5. *Observe the PELs, TLVs.* The Permissible Exposure Limits of OSHA and the Threshold Limit Values of the American Conference of Governmental Industrial Hygienists should not be exceeded (13).

B. Chemical Hygiene Responsibilities

Responsibility for chemical hygiene rest at all levels (6, 11, 21) including the:

1. *Chief executive officer*, who has ultimate responsibility for chemical hygiene within the institution, and must with other administrators, provide continuing support for institutional chemical hygiene (7, 11).

2. *Supervisor of the department or other administrative unit*, who is responsible for chemical hygiene in that unit (7).

3. *Chemical hygiene officer(s)*, whose appointment is essential (7) and who must:

(a) Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices (7);

(b) Monitor procurement, use, and disposal of chemicals used in the lab (8);

(c) See that appropriate audits are maintained (8);

(d) Help project directors develop precautions and adequate facilities (10);

(e) Know the current legal requirements concerning regulated substances (50); and

(f) Seek ways to improve the chemical hygiene program (8, 11).

4. *Laboratory supervisor*, who has overall responsibility for chemical hygiene in the laboratory (21) including responsibility to:

(a) Ensure that workers know and follow the chemical hygiene rules, that protective equipment is available and in working order, and that appropriate training has been provided (21, 22);

(b) Provide regular, formal chemical hygiene and housekeeping inspections including routine inspections of emergency equipment (21, 171);

(c) Know the current legal requirements concerning regulated substances (50, 231);

(d) Determine the required levels of protective apparel and equipment (156, 160, 162); and

(e) ensure that facilities and training for use of any material being ordered are adequate (215).

5. *Project director or director of other specific operation*, who has primary responsibility for chemical hygiene procedures for that operation (7).

6. *Laboratory worker*, who is responsible for:

(a) Planning and conducting each operation in accordance with the institutional chemical hygiene procedures (7, 21, 22, 230); and
(b) Developing good personal chemical hygiene habits (22).

C. The Laboratory Facility

1. *Design.* The laboratory facility should have:

(a) An appropriate general ventilation system (see C4 below) with air intakes and exhausts located so as to avoid intake of contaminated air (194);

(b) Adequate, well-ventilated stockrooms/storerooms (218, 219);

(c) Laboratory hoods and sinks (12, 162);

(d) Other safety equipment including eyewash fountains and drench showers (162, 169); and

(e) Arrangements for waste disposal (12, 240).

2. *Maintenance.* Chemical-hygiene-related equipment (hoods, incinerator, etc.) should undergo continuing appraisal and be modified if inadequate (11, 12).

3. *Usage.* The work conducted (10) and its scale (12) must be appropriate to the physical facilities available and, especially, to the quality of ventilation (13).

4. *Ventilation.*-(a) *General laboratory ventilation.* This system should: Provide a source of air for breathing and for input to local ventilation devices (199); it should not be relied on for protection from toxic substances released into the laboratory (198); ensure that laboratory air is continually replaced, preventing increase of air concentrations of toxic substances during the working day (194); direct air flow into the laboratory from non-laboratory areas and out to the exterior of the building (194).

(b) *Hoods.* A laboratory hood with 2.5 linear feet of hood space per person should be provided for every 2 workers if they spend most of their time working with chemicals (199); each hood should have a continuous monitoring device to allow convenient confirmation of adequate hood performance before use (200, 209). If this is not possible, work with substances of unknown toxicity should be avoided (13) or other types of local ventilation devices should be provided (199). See pp. 201-206 for a discussion of hood design, construction, and evaluation.

(c) *Other local ventilation devices.* Ventilated storage cabinets, canopy hoods, snorkels, etc. should be provided as needed (199). Each canopy hood and snorkel should have a separate duct (207).

(d) *Special ventilation areas.* Exhaust air from glove boxes and isolation rooms should be passed through scrubbers or other treatment before release into the regular exhaust system (208). Cold rooms and warm rooms should have provisions for rapid escape in the event of electrical failure (209).

(e) *Modifications.* Any alteration of the ventilation system should be made only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate (12, 193, 204).

(f) *Performance*. Rate: 4-12 room air changes/hour is normally adequate general ventilation if local exhaust systems such as hoods are used as the primary method of control (194).

(g) *Quality*. General air flow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas (194,195); airflow into and within the hood should not be excessively turbulent (200); hood face velocity should be adequate (typically 60-100 fpm) (200, 204).

(h) *Evaluation*. Quality and quantity of ventilation should be evaluated on installation (202), regularly monitored (at least every 3 months) (6, 12, 14, 195), and reevaluated whenever a change in local ventilation devices is made (12, 195, 207). See pp. 195-198 for methods of evaluation and for calculation of estimated airborne contaminant concentrations.

D. Components of the chemical Hygiene Plan

1. Basic Rules and Procedures

(Recommendations for these are given in section E, below)

2. Chemical Procurement, Distribution, and Storage

(a) *Procurement*. Before a substance is received, information on proper handling, storage, and disposal should be known to those who will be involved (251, 216). No container should be accepted without an adequate identifying label (216).

(b) *Stockrooms/storerrooms*. Toxic substances should be segregated in a well-identified area with local exhaust ventilation (221). Chemicals which are highly toxic (227) or other chemicals whose containers have been opened should be in unbreakable secondary containers (219). Stored chemicals should be examined periodically (at least annually) for replacement, deterioration, and container integrity (218-19).

Stockrooms/storerrooms should not be used as preparation or repackaging areas, should be open during normal working hours, and should be controlled by one person (219).

(c) *Distribution*. When chemicals are hand carried, the container should be placed in an outside container or bucket. Freight-only elevators should be used if possible (223).

(d) *Laboratory storage*. Amounts permitted should be as small as practical. Storage on bench tops and in hoods is inadvisable. Exposure to heat or direct sunlight should be avoided. Periodic inventories should be conducted, with unneeded items being discarded or returned to the storeroom/stockroom (225-6, 229).

3. Environmental Monitoring

Regular instrumental monitoring of airborne concentration is not usually justified or practical in laboratories but may be appropriate when testing or redesigning hoods or other ventilation devised (12) or when a highly toxic substance is stored or used regularly (e.g., 3 times/week) (13).

4. Housekeeping, Maintenance, and Inspections

(a) *Cleaning*. Floors should be cleaned regularly (24).

(b) *Inspections*. Formal housekeeping and chemical hygiene inspections should be held at least quarterly (6, 21) for units which have frequent personnel changes and semiannually for other; informal inspections should be continual (21).

(c) *Maintenance*. Eye wash fountains should be inspected at intervals of not less than 3 months (6). Respirators for routine use should be inspected periodically by the laboratory supervisor (169). Safety showers should be tested routinely (169). Other safety equipment should be inspected regularly. (e.g., every 3-6 months) (6, 24,171). Procedures to prevent restarting of out-of-service equipment should be established (25).

(d) *Passageways*. Stairways and hallways should not be used as storage areas (24). Access to exits, emergency equipment, and utility controls should never be blocked (24).

5. Medical Program

(a) *Compliance with regulations*. Regular medical surveillance should be established to the extent required by regulations (12).

(b) *Routine surveillance*. Anyone whose work involves regular and frequent handling of toxicologically significant quantities of a chemical should consult a qualified physician to determine on an individual basis whether a regular schedule of medical surveillance

is desirable (11, 50).

(c) *First aid*. Personnel trained in first aid should be available during working hours and an emergency room with medical personnel should be nearby (173). See pp. 176-178 for description of some emergency first aid procedures.

6. Protective Apparel and Equipment

These should include for each laboratory:

- Protective apparel compatible with the required degree of protection for substance being handled (158-161);
- An easily accessible drench-type safety shower (162, 169);
- An eyewash fountain (162);
- A fire extinguisher (162-164);
- Respiratory protection (164-9), fire alarm and telephone for emergency use (162) should be available nearby; and
- Other items designated by the laboratory supervisor (156, 160).

7. Records

(a) Accident records should be written and retained (174).

(b) Chemical Hygiene Plan records should document that the facilities and precautions were compatible with current knowledge and regulations (7).

(c) Inventory and usage records for high-risk substances should be kept as specified in sections E3e below.

(d) Medical records should be retained by the institution in accordance with the requirements of state and federal regulations (12).

8. Signs and Labels

Prominent signs and labels of the following types should be posted:

- Emergency telephone numbers of emergency personnel/facilities, supervisors, and laboratory workers (28);
- Identity labels, showing contents of containers (including waste receptacles) and associated hazards (27, 48);
- Locations signs for safety showers, eyewash stations, other safety and first aid equipment, exits (27) and areas where food and beverage consumption and storage are permitted (24); and
- Warnings at areas or equipment where special or unusual hazards exist (27).

9. Spills and Accidents

(a) A written emergency plan should be established and communicated to all personnel; it should include procedures for ventilation failure (200), evacuation, medical care, reporting, and drills (172).

(b) There should be an alarm system to alert people in all parts of the facility including isolation areas such as cold rooms (172).

(c) A spill control policy should be developed and should include consideration of prevention, containment, cleanup, and reporting (175).

(d) All accidents or near accidents should be carefully analyzed with the results distributed to all who might benefit (8, 28).

10. Information and Training Program

(a) *Aim*: To assure that all individuals at risk are adequately informed about the work in the laboratory, its risks, and what to do if an accident occurs (5, 15).

(b) *Emergency and Personal Protection Training*: Every laboratory worker should know the location and proper use of available protective apparel and equipment (154, 169). Some of the full-time personnel of the laboratory should be trained in the proper use of emergency equipment and procedures (6).

Such training as well as first aid instruction should be available to (154) and encouraged for (176) everyone who might need it.

(c) *Receiving and stockroom/storerroom personnel* should know about hazards, handling equipment, protective apparel, and relevant regulations (217).

(d) *Frequency of Training*: The training and education program should be a regular, continuing activity-not simply an annual presentation (15).

(e) *Literature/Consultation*: Literature and consulting advice concerning chemical hygiene should be readily available to

laboratory personnel, who should be encouraged to use these information resources (14).

11. Waste Disposal Program

(a) Aim: To assure that minimal harm to people, other organisms, and the environment will result from the disposal of waste laboratory chemicals (5).

(b) Content (14,232, 233, 240): The waste disposal program should specify how waste is collected, segregated, stored, and transported and include consideration of what materials can be incinerated. Transport from the institution must be in accordance with DOT regulations (244).

(c) Discarding Chemical Stocks: Unlabeled containers of chemicals and solutions should undergo prompt disposal; if partially used, they should not be opened (24, 270).

Before a worker's employment in the laboratory ends, chemicals for which that person was responsible should be discarded or returned to storage (226).

(d) Frequency of Disposal: Waste should be removed from laboratories to a central waste storage area at least once per week and from the central waste storage area at regular intervals (14).

(e) Method of Disposal: Incineration in an environmentally acceptable manner is the most practical disposal method for combustible laboratory waste (14, 238, 241).

Indiscriminate disposal by pouring waste chemicals down the drain (14, 231,242) or adding them to mixed refuse for landfill burial is unacceptable (14).

Hoods should not be used as a means of disposal for volatile chemical (40, 200).

Disposal by recycling (233, 243) or chemical decontamination should be used when possible.

E. Basic Rules and Procedures for Working with Chemicals

The Chemical Hygiene Plan should require that laboratory workers know and follow its rules and procedures. In addition to the procedures of the sub programs mentioned above, these should include the rules listed below.

1. General Rules

The following should be used for essentially all laboratory work with chemicals:

(a) *Accidents and spills*-eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention (33, 172).

Ingestion: Encourage the victim to drink large amounts of water (178).

Skin Contact: Promptly flush the affected area with water (33, 172, 178) and remove any contaminated clothing (172, 178). If symptoms persist after washing, seek medical attention (33).

Clean-up. Promptly clean up spills, using appropriate protective apparel and equipment and proper disposal (24, 33). See pp. 233-237 for specific clean-up recommendations.

(b) *Avoidance of "routine" exposure*; Develop and encourage safe habits (230); avoid unnecessary exposure to chemicals by any route (23);

Do not smell or taste chemicals (32). Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices (199).

Inspect gloves (157) and test glove boxes (208) before use.

Do not allow release of toxic substances in cold rooms and worm rooms, since these have contained recirculated atmospheres (209).

(c) *Choice of chemicals*: Use only those chemicals for which the quality of the available ventilation system is appropriate (13).

(d) *Eating, smoking, etc.*: Avoid eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present (22, 24, 32, 40); wash hands before conducting these activities.

Avoid storage, handling, or consumption of food or beverages in storage areas, refrigerators, glassware or utensils which are also used for laboratory operations (23, 24, 226).

(e) *Equipment and glassware*: handle and store laboratory glassware with care to avoid damage; do not use damaged

glassware (250). Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur (25). Use equipment only for its designed purpose (23, 26).

(f) *Exiting*: Wash areas of exposed skin well before leaving the laboratory (23).

(h) *Horseplay*: Avoid practical jokes or other behavior which might confuse, startle or distract another worker (23).

(i) *Personal apparel*: Confine long hair and loose clothing (23, 158). Wear shoes at all time in the laboratory but do not wear sandals, perforated shoes, or sneakers (158).

(j) *Personal housekeeping*: Keep the work area clean and uncluttered, with chemicals and equipment being properly labeled and stored; clean up the work area on completion of an operation or at the end of each day (24).

(k) *Personal protection*: Assure that appropriate eye protection (154-156) is worn by all persons, including visitors, where chemicals are stored or handled (22, 23, 33, 154).

Wear appropriate gloves when the potential for contact with toxic materials exists (157); inspect the gloves before each use, wash them before removal, and replace them periodically (157). (A table of resistance to chemicals of common glove materials is given p. 159).

Use appropriate (164-168) respiratory equipment when air contaminant concentrations are not sufficiently restricted by engineering controls (164-5), inspecting the respirator before use (169).

Use any other protective and emergency apparel and equipment as appropriate (22, 157-162).

Avoid use of contact lenses in the laboratory unless necessary; if they are used, inform supervisor so special precautions can be taken (155).

Remove laboratory coats immediately on significant contamination (161).

(l) *Planning*: Seek information and advice about hazards (7), plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation (22, 23).

(m) *Unattended operations*: Leave lights on, place an appropriate sign on the door, and provide for containment of toxic substance in the event of failure of a utility service (such as cooling water) to an unattended operation (27, 128).

(n) *Use of hood*: use the hood for operations which might result in release of toxic chemical vapors or dust (198-9).

As a rule of thumb, use a hood or other local ventilation device when working with any appreciably volatile substance with a TLV of less than 50 ppm (13).

Confirm adequate hood performance before use; keep hood closed at all times except when adjustments within the hood are being made (200); keep materials stored in hoods to a minimum and do not allow them to block vents or air flow (200).

Leave the hood "on" when it is not in active use if toxic substances are stored in it or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off" (200).

(o) *Vigilance*: Be alert to unsafe conditions and see that they are corrected when detected (22).

(p) *Waste disposal*: Assure that the plan for each laboratory operation includes plans and training for waste disposal (230). Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the Chemical Hygiene Plan (22, 24).

Do not discharge to the sewer concentrated acids or bases (231); highly toxic, malodorous, or lachrymatory substances (231); or any substances which might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, cause structural damage or obstruct flow (242).

(q) *Working alone*: Avoid working alone in a building; do not work alone in a laboratory if the procedures being conducted are hazardous (28).

2. Working with Allergens and Embryotoxins

(a) *Allergens* (examples: diazomethane, isocyanates, bichromates): Wear suitable gloves to prevent hand contact with allergens or substances of unknown allergenic activity (35).
(b) *Embryotoxins* (34-5) (examples: organomercurials, lead compounds, formamide): If you are a woman of childbearing age, handle these substances only in a hood whose satisfactory performance has been confirmed, using appropriate protective apparel (especially gloves) to prevent skin contact. Review each use of these materials with the research supervisor and review continuing uses annually or whenever a procedural change is made.

Store these substances, properly labeled, in an adequately ventilated area in an unbreakable secondary container. Notify supervisors of all incidents of exposure or spills; consult a qualified physician when appropriate.

3. Work with Chemicals of Moderate Chronic or High Acute Toxicity

Examples: diisopropylfluorophosphate (41), hydrofluoric acid (43), hydrogen cyanide (45).

Supplemental rules to be followed in addition to those mention above (Procedure B of "Prudent Practices" pp. 39-41):

(a) *Aim:* To minimize exposure to these toxic substances by any route using all reasonable precautions (39).

(b) *Applicability:* These precautions are appropriate for substances with moderate chronic or high acute toxicity used in significant quantities (39).

(c) *Location:* use and store these substances only in areas of restricted access with special warning signs (40, 229).

Always use a hood (previously evaluated to confirm adequate performance with a face velocity of at least 60 linear feet per minute) (40) or other containment device for procedures which may result in the generation of aerosols or vapors containing the substance (39); trap released vapors to prevent their discharge with the hood exhaust (40).

(d) *Personal protection:* Always avoid skin contact by use of gloves and long sleeves (and other protective apparel as appropriate) (39). Always wash hands and arms immediately after working with these materials (40).

(e) *Records:* Maintain records of the amounts of these materials on hand, amounts used, and the names of the workers involved (40, 229).

(f) *Prevention of spills and accidents:* Be prepared for accidents and spills (41).

Assure that at least 2 people are present at all times if a compound in use is highly toxic or of unknown toxicity (39).

Store breakable containers of these substances in chemically resistant trays; also work and mount apparatus above such tray or cover work and storage surfaces with removable, absorbent, plastic backed paper (40).

If a major spill occurs outside the hood, evacuate the area; assure that cleanup personnel wear suitable protective apparel and equipment (41).

(g) *Waste:* Thoroughly decontaminate or incinerate contaminated clothing or shoes (41). If possible, chemically decontaminate by chemical conversion (40).

Store contaminated waste in closed, suitably labeled, impervious containers (for liquids, in glass or plastic bottles half-filled with vermiculite) (40).

4. Work with chemicals of High Chronic Toxicity (Examples: dimethylmercury and nickel carbonyl (48), benzo-a-pyrene

(51), N-nitrosodiethylamine (54), other human carcinogens or substances of known high chronic toxicity (in quantities above a few milligrams to a few grams, depending on the substance) (47). (Procedure A of "Prudent Practices" pp. 47-50).

(a) *Access:* Conduct all transfers and work with these substances in a "controlled area": a restricted access hood, glove box, or portion of a lab, designated for use of highly toxic substances, for which all people with access are aware of the substance being used

and necessary precautions (48).

(b) *Approvals:* Prepare a plan for use and disposal of these materials and obtain the approval of the laboratory supervisor (48).

(c) *Non-contamination/Decontamination:* protect vacuum pumps against contamination by scrubbers or HEPA filters and vent them into the hood (49). Decontaminate vacuum pumps or other contaminated equipment, including glassware, in the hood before removing them from the controlled area (49, 50). Decontaminate the controlled area before normal work is resumed there (50).

(d) *Exiting:* On leaving a controlled area, remove any protective apparel (placing it in an appropriate, labeled container) and thoroughly wash hands, forearms, face, and neck (49).

(e) *Housekeeping:* Use a wet mop or a vacuum cleaner equipped with a HEPA filter instead of dry sweeping if the toxic substance was a dry powder (50).

(f) *Medical surveillance:* If using toxicologically significant quantities of such a substance on a regular basis (e.g., 3 times per week), consult a qualified physician concerning desirability of regular medical surveillance (50).

(g) *Records:* Keep accurate records of the amounts of these substances stored (229) and used, the dates of use, and names of users (48).

(h) *Signs and labels:* Assure that the controlled area is conspicuously marked with warning and restricted access signs (49) and that all containers of these substances are appropriately labeled with identity and warning labels (48).

(i) *Spills:* Assure that contingency plans, equipment, and materials to minimize exposures of people and property in case of accident are available (233-4).

(j) *Storage:* Store containers of these chemicals only in a ventilated, limited access (48, 227, 229) area in appropriately labeled, unbreakable, chemically resistant, secondary containers (48, 229).

(k) *Glove boxes:* For a negative pressure glove box, ventilation rate must be at least 2 volume changes/hour and pressure at least 0.5 inches of water (48). For a positive pressure glove box, thoroughly check for leaks before each use (49). In either case, trap exit gases of filter them through a HEPA filter and then release them into the hood (49).

(l) *Waste:* Use chemical decontamination whenever possible; ensure that containers of contaminated waste (including washings from contaminated flasks) are transferred from the controlled area in a secondary container under the supervision of authorized personnel (49, 50, 233).

5. Animal Work with Chemicals of High Chronic Toxicity

(a) *Access:* For large scale studies, special facilities with restricted access are preferable (56).

(b) *Administration of the toxic substance:* When possible, administer the substance by injection or gavage instead of in the diet. If administration is in the diet, use a caging system under negative pressure or under laminar air flow directed toward HEPA filters (56).

(c) *Aerosol suppression:* Devise procedures which minimize formation and dispersal of contaminated aerosols, including those from food, urine, and feces (e.g., use HEPA filtered vacuum equipment for cleaning, moisten contaminated bedding before removal from the cage, mix diets in closed containers in a hood) (55, 56).

(d) *Personal protection:* When working in the animal room, wear plastic or rubber gloves, fully buttoned laboratory coat or jumpsuit and, if needed because of incomplete suppression of aerosols, other apparel and equipment (shoe and head coverings, respirator) (56).

(e) *Waste disposal:* Dispose of contaminated animal tissues and excreta by incineration if the available incinerator can convert the contaminant to non-toxic products (238); otherwise package the waste appropriately for burial in an EPA-approved site (239).

F. Safety Recommendations

The above recommendations from "Prudent Practices" do not

include those which are directed primarily toward prevention of physical injury rather than toxic exposure. However, failure of precautions against injury will often have the secondary effect of causing toxic exposures. Therefore, we list below page references for recommendations concerning some of the major categories of safety hazards which also have implications for chemical hygiene:

1. Corrosive agents: (35-6)
2. Electrically powered laboratory apparatus: (179-92)
3. Fires, explosions: (26, 57-74, 162-4, 174-5, 219-20, 226-7)
4. Low temperature procedures: (26, 88)
5. Pressurized and vacuum operations (including use of compressed gas cylinders): (27, 75-101)

G. Material Safety Data Sheets

Material safety data sheets are presented in "Prudent Practices" for the chemicals listed below. (Asterisks denote that comprehensive material safety data sheets are provided).

- *Acetyl peroxide (105)
- *Acrolein (106)
- *Acrylonitrile (107)
- Ammonia (anhydrous) (91)
- *Aniline (109)
- *Benzene (110)
- *Benzo[a]pyrene (112)
- *Bis(chloromethyl) ether (113)
- Boron trichloride (91)
- Boron trifluoride (92)
- Bromine (114)
- *Tert-butyl hydroperoxide (148)
- *Carbon disulfide (116)
- Carbon monoxide (92)
- *Carbon tetrachloride (118)
- *Chlorine (119)
- Chlorine trifluoride (94)
- *Chloroform (121)
- Chloromethane (93)
- *Diethyl ether (122)
- Diisopropyl fluorophosphate (41)
- *Dimethylformamide (123)
- *Dimethyl sulfate (125)
- *Dioxane (126)
- *Ethylene dibromide (128)
- *Fluorine (95)
- *Formaldehyde (130)
- *Hydrazine and salts (132)
- Hydrofluoric acid (43)
- Hydrogen bromide (98)
- Hydrogen chloride (98)
- *Hydrogen sulfide (135)
- Mercury and compounds (52)
- *Methanol (137)
- *Morpholine (138)
- *Nickel carbonyl (99)
- *Nitrobenzene (139)
- Nitrogen dioxide (100)
- N-nitrosodiethylamine (54)
- *Peracetic acid (141)
- *Phenol (142)
- *Phosgene (143)
- *Pyridine (144)
- *Sodium azide (145)
- *Sodium cyanide (147)
- Sulfur dioxide (101)
- *Trichloroethylene (149)
- *Vinyl chloride (150)

Appendix B to 1910.1450-References (Non-Mandatory)

The following references are provided to assist the employer in the development of a Chemical Hygiene Plan. The materials listed below are offered as non-mandatory guidance. References listed here do not imply specific endorsement of a book, opinion, technique, policy or a specific solution for a safety or health

problem. Other references not listed here may better meet the needs of a specific laboratory. (a) Materials for the development of the Chemical Hygiene Plan:

1. American Chemical Society, Safety in the Academic Chemistry Laboratories, 4th edition, 1985.
 2. Fawcett, H.H. and W.S. Wood, Safety and Accident Prevention in Chemical Operations, 2nd edition, Wiley-Interscience, New York, 1982.
 3. Flury, Patricia A., Environmental Health and Safety in the Hospital Laboratory, Charles C. Thomas Publisher, Springfield IL., 1978.
 4. Green, Michael E. and Turk, Amos, Safety in Working with Chemicals, Macmillan Publishing co., NY, 1978.
 5. Kaufman, James a., Laboratory Safety Guidelines, Dow Chemical Co., Box 1713, Midland MI 48640, 1977.
 6. National Institutes of Health, NIH Guidelines for the Laboratory use of Chemical Carcinogens, NIH Pub. No. 81-2385, GPO Washington, DC 20402, 1981.
 7. National Research Council, Prudent Practices for Disposal of Chemicals from Laboratories, National Academy Press, Washington DC, 1983.
 8. National Research Council, Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Academy Press, Washington DC, 1981.
 9. Renfrew, Malcolm, Ed., Safety in the Chemical Laboratory, Vol. IV, *J. Chem. Ed.*, American Chemical Society, Easlton, PA, 1981.
 10. Steere, Norman V., Ed., Safety in the Chemical Laboratory, *J. Chem. Ed.* American Chemical Society, Easlton, PA 18042, Vol. I, 1967, Vol. II, 1971, Vol. III 1974.
 11. Steere, Norman, V., Handbook of Laboratory Safety, the Chemical Rubber Company Cleveland, OH, 1971.
 12. Young, Jay A., Ed., Improving safety in the Chemical Laboratory, John Wiley & Sons, Inc. New York, 1987.
- (b) Hazardous Substances Information:
1. American conference of Governmental Industrial Hygienists, Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes, P.O. Box 1937 Cincinnati, OH 45201 (latest edition).
 2. Annual Report on Carcinogens, National Toxicology Program U.S. Department of Health and Human Services, Public Health Service, U.S. Government Printing Office, Washington DC (latest edition).
 3. Best Company, Best Safety Directory, Vols. I and II, Oldwick, N.J., 1981.
 4. Bretherick, L., Handbook of reactive Chemical Hazards, 2nd edition, Butterworths, London, 1979.
 5. Bretherick, L., Hazards in the Chemical Laboratory, 3rd edition, royal Society of Chemistry, London, 1986.
 6. Code of Federal Regulations, 29 CFR part 1910 subpart Z. U.S. Govt. Printing Office, Washington, DC 20402 (latest edition).
 7. IARC Monographs on the Evaluation of the carcinogenic Risk of Chemicals to Man, World Health Organization Publications Center, 49 Sheridan Avenue, Albany, New York 12210 (latest editions).
 8. NIOSH/OSHA pocket Guide to Chemical hazards, NIOSH Pub. No. 85-11, U.S. Government Printing Office, Washington, DC, 1985 (or latest edition).
 9. Occupational Health Guidelines, NIOSH/OSHA NIOSH Pub. No. 81-123 U.S. Government Publishing Office, Washington, DC, 1981.
 10. Patty, F.F., Industrial Hygiene and Toxicology, John Wiley & Sons, Inc., New York, NY (five Volumes).
 11. Registry of Toxic Effects of Chemical Substances, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Revised Annually, for sale from Superintendent of Documents U.S. Govt. Printing Office, Washington, DC 20402.
 12. The Merck Index: An Encyclopedia of Chemicals and Drugs, Merck and Company Inc., Rahway, N.J., 1976 (or latest

edition).

13. Sax, N.I. Dangerous Properties of Industrial Materials, 5th edition, Van Nostrand Reinhold, NY., 1979.

14. Sittig, Marshall, Handbook of Toxic and Hazardous Chemicals, Noyes Publications, Park Ridge, NJ, 1981.

(c) Information of Ventilation:

1. American Conference of Governmental Industrial Hygienists Industrial Ventilation, 16th edition Lansing, MI, 1980.

2. American National Standards Institute, Inc. American National Standards Fundamentals Governing the Design and Operation of Local Exhaust Systems ANSI Z 9.2-1979 American National Standards Institute, N.Y., 1979.

3. Imad, A.P. and Watson, C.L. Ventilation Index: An Easy Way to Decide about Hazardous Liquids, Professional Safety pp 15-18, April 1980.

4. National Fire Protection Association, Fire Protection for Laboratories Using Chemicals NFPA-45, 1982.

Safety Standard for Laboratories in Health Related Institutions,

NFPA, 56c, 1980.

Fire Protection Guide on Hazardous Materials, 7th edition, 1978. National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

5. Scientific Apparatus Makers Association (SAMA), Standard for Laboratory Fume Hoods, SAMA LF-71980, 1101 16th Street, NW., Washington, C 20036.

(d) Information on Availability of Referenced Material:

1. American National Standards Institute (ANSI), 1430 Broadway, New York, NY 10018.

2. American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA 19103.

(Approved by the Office of Management and Budget under control number 1218-0131)

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APPENDIX C: Personnel Contact List

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East Hampton Board of Education: (term ends)

Mark Laraia (2013) Chairperson

Joanne Barmasse (2013) Acting Chair

Carol Lane (2013) Secretary

Scott Minnick (2015) Acting Secretary

Kenneth Barber (2015)

Donald Coolican (2015)

Glenn Gemma (2013)

William Marshall (2015)

Josh Piteo (2013)